Tinea Capitis Due to Trichophyton Tonsurans

Incidence, Diagnosis and Epidemiology in the San Francisco Bay Region

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• *Eighty-five cases of tinea capitis due to T. tonsurans were observed in the San Francisco Bay area during the five years 1950-54.*

This disease, unlike the common microsporum infections, sometimes affects adults and adolescents.

Hairs infected with T. tonsurans do not fluoresce under the Wood's light. Diagnosis is a laboratory procedure in which the fungus is isolated from the hair.

There are three clinical varieties of the disease. The course is prolonged and treatment is unsatisfactory.

The disease apparently has spread from Mexico, through the Southwest and Southern California. Control is difficult.

SINCE MOST PHYSICIANS are familiar with the common microsporum ringworm of the scalp, the primary purpose in this presentation is to discuss tinea capitis caused by a species of fungus which has been observed recently in the San Francisco Bay area. This organism, Trichophyton tonsurans, has been found in tinea capitis in increasing numbers of cases throughout the United States, especially the Southwest, in the last few years. A large number of cases was reported from the Los Angeles area in 1952.[4,7]

Scalp infection by T. tonsurans does not always undergo spontaneous cure at puberty as do the microsporum infections. Consequently, this disease may be found in adolescents and adults. Trichophyton tonsurans-infected hairs, in contrast to microsporum-infected hairs, do not fluoresce under filtered ultraviolet (Wood's) light. Yet another characteristic of T. tonsurans infections is the great variation in clinical manifestations in different patients. While the most common clinical findings are scattered, irregular areas of alopecia, short broken hairs and pustular folliculitis, the clinical picture may vary from mild seborrhea-like scaling to severe kerion with scarring and permanent alopecia. For these reasons, along with its infectiousness, indolence and chronicity, tinea capitis due to T. tonsurans presents a most difficult diagnostic, therapeutic and epidemiologic problem.

INCIDENCE

One of the authors first made the diagnosis of T. tonsurans infection of the scalp in 1950, and since that time the disease has been found in 52 patients—42 from the Stanford Dermatology Clinic in San Francisco and ten from the north San Francisco Bay area who were seen in private practice. Thirty of the cases were diagnosed during 1954. During this same period 278 patients with microsporum infections of the scalp were observed. Thus, of a total of 330 cases during the past five years, 16 per cent were caused by T. tonsurans.

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Table 1 shows the relative incidence of the various species of fungi in tinea capitis cases at the Stanford Dermatology Clinic and in private practice in the North Bay area. It appears that M. audouini causes most of the infections in clinic patients in San Francisco (69 per cent of 205 cases at Stanford) whereas in the North Bay region M. canis is more common. In a survey of dermatologists in the immediate areas surrounding most of San Francisco Bay, M. canis was reported most frequently as the cause of tinea capitis. Vallejo is probably a representative community in this respect, with 63 per cent of the cases due to M. canis. However, there are localities outside San Francisco, for example, Benicia, only 6 miles from Vallejo, where 83 per cent of the cases are due to M. audouini.

Thirty-three cases of T. tonsurans infections of the scalp in the five years covered by this study were reported in a survey the authors made of Bay Area dermatologists. These, with the 52 cases already mentioned, make a total of 85 cases of tinea capitis in this area from which T. tonsurans was isolated.

CLINICAL MANIFESTATIONS

Microsporum scalp infections occur almost exclusively in childhood and fall into two general clinical types: (1) Indolent, scaly, "gray patches,"

TABLE 1.—*The relative incidence of fungi responsible for tinea capitis in the San Francisco Bay Area (1950-1954)*

	M. audouini		M. canis		T. tonsurans	
San Francisco (Stanford Dermatology Clinic)	141	69%	22	11%	42	20%
North Bay Area	50	40%	65	52%	10	8%
Total	191	58%	87	26%	52	16%

Total cases 330.

TABLE 2.—*The characteristics of tinea capitis as seen in the San Francisco Bay Area*

	T. tonsurans	M. audouini	M. canis
Age	Adolescents and adults as well as children	Children	Children
Sex	More males	More males	More males
Spontaneous cure at puberty	No	Yes	Yes
Wood's light reaction	No characteristic fluorescence (infected hairs may appear dull gray)	Infected hairs green	Infected hairs green
Clinical appearance	Irregular bald patches interspersed with normal hairs. Scaling. Pustules and kerion common. Pruritic.	"Gray patches" of broken hairs. Inflammatory reaction infrequent.	"Gray patches." Inflammation. Pustules or kerion common.
Organism in hair	Large-spore endothrix	Small-spore ectothrix	Small-spore ectothrix
Source	Human	Human	Animal and human

single or multiple, with minimal inflammation. These are mostly due to the "human type" fungus, M. audouini, spread from child to child. (2) Inflammatory lesions, either pustular or with large boggy kerions associated with secondary bacterial infection. These are most commonly due to M. canis, which may be acquired from animals, particularly kittens. In both inflammatory and noninflammatory lesions infected hairs become lusterless and brittle and they break off or fall out. These hairs are more easily plucked than those not infected. Itching is not a common complaint. There may be enlargement of the posterior cervical nodes and pain with the pustular or kerion reaction. No attempt was made to determine how many of the tinea capitis patients observed by the authors had coexistent tinea corporis, but certainly a large percentage had lesions on the glabrous skin. Microsporum-infected hairs have a greenish fluorescence under a Wood's light.

Trichophyton tonsurans infections of the scalp may be clinically identical to those produced by the microsporum species. The hairs are not fluorescent. However, in 11 patients, infected hairs appeared dull gray under the Wood's light. The authors have been able to distinguish three clinical types of T. tonsurans infections which are suggestive but not diagnostic (Table 2):

Type I. SEBORRHEA-LIKE: Lesions with scaling or itching in irregular indolent patches resembling seborrhea (Figure 1). Often the patients are unaware of the disease because of the minimal symptoms. There is little loss of hair, and only by intensive searching, preferably with a hand lens, can a few broken hairs be found. There is little or no visible erythema. (With regard to this generalization, however, it should be noted that most of the patients we observed were Negroes.) The patches in the scalp are not well defined as in classical "ringworm," but are usually irregular or along the part in the hair, most often with moderately thick greasy scales. The "ringworm" pattern may be seen on the glabrous skin. Adolescent and adult patients who were observed showed this indolent form of the disease over a period of years.

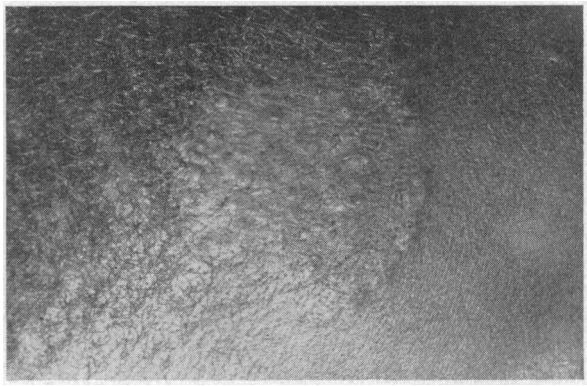

Figure 1.—Infected area at temporal hairline. Note the classical papulo-vesicular raised "ringworm" margin on the glabrous skin. This is absent above the hairline, suggesting a different immunologic response in the scalp.

Perhaps most significant is the paucity of signs and symptoms in this form of infection. Several of the children's parents brought the patients stating they could see lesions on the scalp, whereas grossly the authors could see little or nothing abnormal. The diagnosis was established only when the cultures were grown. It was often difficult to select a site from which to make the culture. Twelve (23 per cent) of the patients in the present series had this mild form of the infection. Five of the 12 were over 12 years of age.

Figure 2.—Follicular pustules in Type II infection. No well-defined patch is found.

Figure 3.—Two kerions on the vertex of the scalp (Type III).

Occasionally a few "black dot hairs" were noted —brittle infected hairs broken off in the follicle at or just below the skin surface. These were sometimes covered by scales and were revealed only after shampoo or keratolytic medication removed the scales. In the present series only six patients had a great number of "black dot hairs."

Type II. PUSTULAR: Lesions consisting solely of follicular pustules which may appear sometimes in areas of erythema and alopecia (Figure 2). Some of these lesions were round or oval in shape, with accuminate pustules, while in other cases there were only a few pustules in lesions that otherwise resembled those of Type I. Occasionally long normal hairs appeared interspersed in areas of alopecia or in areas of short, broken infected hairs. Infected hairs are easily epilated manually whereas normal hairs are not. Twenty-four (46 per cent) of the patients in the series, all under 12 years of age, had this form of the disease.

Type III. KERION: Frank kerion formation associated with secondary bacterial invasion which shows severe tissue reactions and large boggy areas indistinguishable from the kerion of microsporum infections (Figure 3). Sixteen (30 per cent) of the patients in the series had lesions of this type. All except one were under 12 years of age. By comparison, kerion developed in 12 per cent of patients observed by us who had M. audouini and 18 per cent of those with M. canis infection.

Pipkin[6] called attention to the relatively high incidence of tinea capitis due to T. tonsurans in adults and adolescents. Three of the patients in the present series were adults (over 16), two were adolescents (12 to 15), and the remaining were children under 12. All the five patients over 12 years of age had the seborrhea-like form of the disease. The average age of the children was five years. The oldest patient was 62; the youngest, 2 years of age. There were 10 females, 42 males. Forty-six were Negroes and six Caucasians.

DIAGNOSIS

In none of the cases in the series could the diagnosis of T. tonsurans infection have been made without laboratory study. The clinical findings and lack of fluorescence could not be relied on alone, even by physicians familiar with the disease. Two procedures, readily applicable in office practice, are essential for diagnosis.

1. Direct examination of hairs or skin scrapings in potassium hydroxide. The hairs from suspected areas that are the easiest to pull out are the hairs most likely to be infected. Broken hair stubbles, if any are seen should be selected for examination. The hairs should be placed on a slide with a drop of 20 per cent potassium hydroxide and gently warmed (not boiled) or allowed to stand for about 30 minutes for "clearing." Examination should then be done under high dry magnification with subdued light.

Hairs infected with T. tonsurans are filled with broad strands of hyphae which readily break up into chains of large spores. These arthrospores vary from cuboidal to spherical in shape, are 4 to 5 microns in diameter, and are arranged linearly within the hair shaft. They are most numerous near the base of the shaft. This is infection of the large-spore endothrix type. In contrast, microsporum-infected hairs with a mosaic sheath of small spores

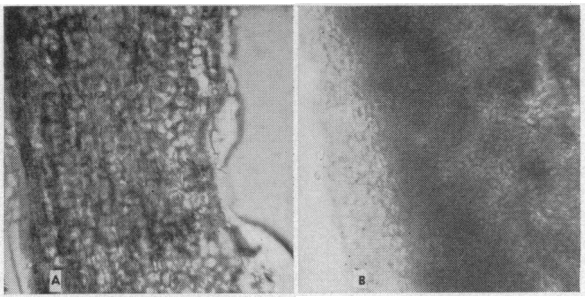

Figure 4.—*(a)* Large endothrix spores of Trichophyton tonsurans seen within the hair shaft. *(b)* Ectothrix spores of microsporum seen as a mosaic sheath on the surface of the hair shaft (×600).

surrounding the outside of the hair shaft have a small-spore ectothrix type of infection (Figure 4).

Scales removed from the scalp by scraping with a dull scalpel should be examined also in potassium hydroxide. These scales sometimes contain hyphal filaments. The hyphae appear identical to those in scrapings from any "ringworm" lesion, regardless of the species causing the infection.

2. Culture. Trichophyton tonsurans can be identified only by culture. It grows rapidly on Sabouraud's agar as white, yellow or tan velvety or powdery colonies. The reverse of the colony may be reddish-brown. The center of the colony may be crateriform. Microscopic mounts from the colony show numerous, large, clavate microconidia growing along the sides of the hyphae or on short lateral branches. The cell of the hyphae from which a microconidium develops generally remains unstained when mounted in lactophenol-cotton blue, whereas the microconidium takes a deep stain. Owing to the great variability in cultures, training in mycology is necessary for identification. Where facilities for proper identification are not readily available, cultures, hairs, or scrapings may be mailed to the State Department of Public Health Laboratory, the various medical school mycology laboratories, or to the Communicable Disease Center of the U. S. Public Health Service. Spores in dry hairs or scrapings remain viable for months or years at room temperature.

EPIDEMIOLOGY

Apparently T. tonsurans infections are transmitted directly or indirectly from human to human. No animal infections have been reported. Kligman and Constant[5] and others have reported family epidemics of T. tonsurans infections. The authors found 24 infected persons in nine families. Five members of one family, three adults, one adolescent and a nine-year-old boy, had Type I infections. All other familial infections were in preadolescent siblings.

Before World War II, M. canis was responsible for most cases of tinea capitis in the United States, mostly from animal sources, especially young cats and dogs, although human to human infections occurred frequently. Following the mass migrations of war workers and their families during World War II, epidemics of M. audouini appeared throughout the country. It is believed that these infections were carried from the large eastern cities, where they had been endemic for years.

Trichophyton tonsurans infection was known to be common in Mexico and Puerto Rico before World War II.[1, 3] There were scattered case reports from the East and Midwest until, in 1952, Pipkin reported a large series from Texas.[6] Since that time T. tonsurans infections have appeared in increasing numbers in the Southwest. Georg[2] expressed belief that these cases were owing to spread of infection from Mexico. Many cases have been reported in Southern California.[4, 7] Now the disease is appearing in Northern California in increasing numbers. Several of the patients in the present series had migrated from Texas and Oklahoma and many lived in housing areas near large government installations.

The Wood's light is of inestimable value in screening school children for microsporum scalp infections during epidemics. Veterinarians also have been alerted to its value in the diagnosis of microsporum infection in animals. Since Trichophyton-infected hairs are not characteristically fluorescent, it is readily seen that control measures are difficult to institute. Yet diagnosis and treatment is essential to prevent widespread epidemics. Nearly 25 per cent of the tinea capitis cases now seen in the Stanford Dermatology Clinic are due to this organism. In addition, eight infections limited to glabrous skin have been observed.

As was stated previously, M. audouini was the fungus most frequently isolated from cases observed in clinic practice seen in San Francisco and M. canis was the most frequently seen in private practice in areas surrounding the Bay. It is believed that T. tonsurans will be found more frequently if it is sought for and cultures are made of material from suspected cases. The technique for making cultures is simple and could be used for screening if school nurses and public health authorities were instructed. However, the cultures must be identified by a mycologist.

Enforced public health measures, including standardized methods of reporting, isolation and care of school children, and adequate instruction of school nurses and physicians should help control the spread of tinea capitis.

COURSE AND TREATMENT

The chief obstacle in treating and controlling T. tonsurans infections is the difficulty in obtaining adequate patient cooperation for follow-up. Patients with infection of Type I or Type II, with minimal, sometimes almost insignificant symptoms, neglect to return and often simply ignore the disease. Adequate patient education is difficult but important. For these reasons it was not possible to make adequate continuing observation of patients in the present series and hence obtain accurate statistics on the course of the disease. The criterion for cure is a negative culture. It is a certainty that the disease lasts for many months or several years. Two of the adult patients in the series had Type I lesions for at least eight years. It is most difficult to determine when a Type I infection is cured.

As in the microsporum infections, inflammation, either with pustules or kerion, is considered a good prognostic sign, as it indicates tissue response. In seven children with inflammatory (Type II or III) forms of the disease, spontaneous cure appeared to have occurred after 12 to 18 months. During most of this time topical fungicides were being applied, but it is questionable that this altered the course of the disease.

Because of poor patient cooperation plus the fact that Types II and III appear to undergo slow but definite spontaneous cure, the authors have not used x-ray depilation in cases of T. tonsurans scalp infections. It must be admitted that the treatment that has been used, consisting of topical applications of several of the many available fungicides, is not readily effective and that any cures obtained were most likely due to the patient's own immunologic mechanism. In the very chronic and indolent Type I infections, x-ray depilation probably is effective therapy.

Most of the authors' efforts have been directed toward controlling the spread of infection. The scalp should be covered at all times with a tight-fitting cotton stocking cap. The caps should be changed daily and the soiled caps boiled. The hair should be cut short (one-fourth inch or less) preferably with clippers, and it should be thoroughly shampooed at least twice weekly. Shampooing after clipping is important in order to wash away infected hairs. Hair clipped off should be burned. The head of the clipping instrument should be sterilized after using, preferably in phenol solution. Care should be taken with bedding, towels and headwear. Close contact with other persons must be avoided as much as possible. Fungicides in an ointment base applied twice daily to infected scalps probably suppress the spread of infection to others. Most important is the careful examination with culture of all members of the family and others in close contact with the infected person. In addition, patients should be cautioned against having haircuts in public barber shops. It has been our policy to allow infected children to attend school and to notify the school health authorities. Only in rare instances—when proper care and cooperation could not be obtained—has it been necessary to exclude infected children from school.

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REFERENCES

1. Carrión, A. L., and Silva, M.: Ringworm of the scalp in Puerto Rico, Puerto Rico J. Pub. Health and Trop. Med., 19:329-391, March 1944.

2. Georg, L. K.: Trichophyton tonsurans ringworm—a new public health problem, Pub. Health Rpts., 67:53-56, Jan. 1952.

3. González Ochoa, A., and Romo Vázquez, B.: Dermatofitos causantes de tiña de la piel cabelluda en la ciudad de Mexico, Rev. d. Inst. Salub. y enferm. trop., 6:145-148, 1945.

4. Howell, J. B., Wilson, J. W., and Caro, M. R.: Tinea capitis caused by Trichophyton tonsurans (sulfureum or crateriform), Arch. Dermat. and Syph., 65:194-205, Feb. 1952.

5. Kligman, A. M., and Constant, E. R.: Family epidemic of tinea capitis due to Trichophyton tonsurans (variety sulfureum), Arch. Dermat. and Syph., 63:493-499, April 1951.

6. Pipkin, J. L.: Tinea capitis in the adult and adolescent, Arch. Dermat. and Syph., 66:9-36, July 1952.

7. Price, H., and Taylor, D. R.: Trichophyton tonsurans (crateriform) infection of the scalp, Calif. Med., 76:283-288, April 1952.